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Reliability and Validity of Short Food Frequency Questionnaire Among Pregnant Females

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Abstract

Background: The food frequency questionnaire (FFQ) is a standard tool to assess long-term dietary intake. Development, reliability and validity of short FFQ depend on the study objective and population characteristics. However assessment of nutritional status of pregnant females is very important.
Objectives: The current study aimed to examine the reliability and validity of a short food frequency questionnaire among pregnant females in the Qazvin, Iran.
Patients and Methods: A total of 553 pregnant females, aged 18 - 40 years, during the third trimester of pregnancy, were included in the study. Statistical analysis of Pearson correlation coefficient, analysis of covariance for logistic regression and factor analysis were performed using SPSS software version 23.
Results: In this study, Pearson correlation coefficients between test and retest for foods was r = 0.845. The Kaiser-Meyer-Oilskin measure of sampling adequacy was 0.584, P values for the Bartlett test of sphericity were all less than 0.001.
Conclusions: The SFFQ has adequate reproducibility and validity for Iranian pregnant females.

Keywords: Diet Surveys, Pregnancy, Validity, Reliability, Food Frequency Questionnaire

1. Background

The food frequency questionnaire is an appropriate tool for dietary assessment in large studies on diet (1, 2). In this retrospective method, respondents are asked to report their frequency of intake of all food and drinks from a list of foods for a particular period of time (3). Content of a list of foods depends on the population characteristics and study objectives (4-7). In recent years, short food frequency questionnaire (SFFQ) is the preferred dietary assessment method for nutritional epidemiological dietary survey since it is less expensive and easier to administer than more traditional dietary assessment methods that assess long-term dietary intake, and it is less difficult for participants to complete. Also data processing time is less than those of more extensive dietary assessment methods (8-10). A short questionnaire (under 100 food items) is easier for querying respondents and provides a smaller chance of response bias due to prior knowledge of diet-disease relationship (1, 11). Considering the differences in demographic and cultural backgrounds, and dietary habits in different people, a different SFFQ or an appropriate modification of the existing questionnaire can be used, and reevaluation of its reliability and validity are needed before the application of SFFQ (12, 13).

In spite of short FFQs all the details of long questionnaires should not be included, they are designed to assess usual intakes of selected foods and nutrients, adequately (4, 14, 15). Nutrition during pregnancy plays a key role in determining mother's health and well-being, as well as those of her child, and may have further influence on health of the children in later life (16-18). Poor maternal weight gain in pregnancy due to an inadequate diet increases the risk of caesarean section, premature delivery, low birth weight and birth defects (19-22). An infant's optimal growth and development directly depends on its mother's diet. Therefore, providing a nourishing diet for pregnant females, results in significantly better infant health outcomes (23, 24). Recent evidence suggests that it may also reduce the risk of chronic diseases in later life. The ability to assess the role of a complex exposure such as maternal diet during pregnancy requires valid instruments (25, 26). However, FFQ is less often developed and validated to assess diet during pregnancy, a period when many dietary changes occur and the use of dietary supplements is common.

2. Objectives

The current study aimed to evaluate the reliability and validity of energy and macronutrient intake by a short food frequency questionnaire in pregnant females of Qazvin, Iran.

3. Patients and Methods

The multistage clustering sampling method was employed and data were collected by a nutritionist who interviewed 553 pregnant females aged 18 - 40 years, in 20 health centers. Sample size was estimated as 553 subjects by considering confidence interval of about 95%, no interest in participating in research 20% and accurately measure of 5%, design effect 1.5 and P = 80%; (Equation 1).

$$n = \frac{\mathrm{DEFF} \times \mathrm{Np}(1-\mathrm{p})}{\frac{d^2}{Z^2_{1-\frac{\alpha}{2}}} \times (N-1) + p \times (1-p)} = 369 \quad (1)$$

First, the dietary intake of 20 subjects was assessed by 24 hours recalls based on the most commonly reported foods and food portion size, 498 subjects participated in the validation study and 35 subjects participated in the twice test-retest reliability. Inclusion criteria of the subjects were: pregnant at 30 - 38 weeks of gestation, non-smoking, non-chronic disease, no special diet during the past years and their willingness to participate in the study. In addition to nutritional information collection, information about the anthropometric measures (weight, height and body mass index) and socio-economic demographic information, including age, family size, gravidity, level of education, occupation and family income level were assessed.

At first, authors took a weekday, weekend and seasonal food intake report from 35 subjects by 24 hours recall questionnaire. This group of pregnant females who participated in the pilot study was different from the ones who participated in the validation study. After reviewing studies and questionnaires credible about food items, a list commonly consumed food was constructed, defining the food portion sizes and dietary habits in participants. Then a new structure of the short food frequency questionnaire was developed and designed for pregnant females.

Authors categorized the main foods by the traditional food groups into eight main food groups: (1) cereals and cereal products (12 subgroups); (2) milk and dairy products (10 subgroups); (3) vegetables (fresh or cooked) (6 subgroups); (4) fruits (fresh, canned and dried fruits) (5 subgroups); (5) meat, eggs and meat products (including organs) (9 subgroups); (6) beverages (6 subgroups); (7) sweets, baked and junk foods (6 subgroups); (8) oils and fats (8 subgroups). These prepared foods were grouped based on similarities in nutrient composition and method of preparation, and they represented similar dietary choices. Therefore, these items were further classified as specific food items according to the main ingredients. The mean intake represented the individual daily salt consumption. The food portion size for each food item based on a standard scale (27) and reported in the 24 hours recalls was determined, 10 categories were used to assess frequency of intake, which were: 1) six or more times per day; 2) four to five times per day; 3) two to three times per day; 4) once a day; 5) five to six times per week; 6) two to four times per week; 7) once a week; 8) one to three times per month; 9) once a month or less; 10) never, asked the participants to report their intake frequency for each food item consumed during the past year, for seasonal food intake, subjects would respond to the frequency of intake at that time.

To determine the validity, content validity were used. Content validity of the SFFQ was determined by conclusion comments seven of dietitians and after receiving responses and revising the questionnaire; finally by deleting foods that were not commonly consumed a short food frequency questionnaire containing 62 food categories was designed.

One of the aims of the present study was to assess the test-retest reliability of the SFFQ developed for the pregnant females. Therefore 20 participants in the twice test-retest reliability study of filling out the FFQ with 14 days interval, at this stage, one food) marinades (with lower correlation coefficients (r = 0.432) was removed from the list of food items and short food frequency questionnaire had 61 items. Factor analysis (measurements of correlations between factors derived from the original measurements) was analyzed by principal component analysis with varimax rotation. The criterion to retain the food items was item loading less than 0.3. Data analysis was performed by the SPSS-23 software. Data were analyzed using the Pearson correlation coefficient and analysis of covariance for logistic regression. $P < 0.05$ were considered significant.

4. Results

The age range of the study subjects was 18 - 40 years, with a mean age of 28.83 $\pm$ 5.3 years. Table 1 demonstrates the main characteristics of the 498 subjects; 46.3% of the subjects were overweight or obese before pregnancy and 37.2% were university educated.

4.1. Daily Food Consumption

The estimated daily intakes of eight main food groups among the subjects are shown in Table 2. The average daily

Table 1. Characteristics of the Subjects[a]

Characteristics, n = 498	No. (%)
Pre-pregnancy BMI, kg/m^2	
< 24.9	267 (53.6)
25 - 29.9	171 (34.3)
> 30	60 (12.0)
Gravidity	
Gravida 1	239 (48.0)
Gravida 2	165 (33.1)
Multi gravida	86 (17.2)
Grand multi gravida	8 (1.6)
Education	
None	2 (0.4)
Primary school	48 (9.6)
Secondary school	74 (14.8)
Trade school	190 (33.0)
University	186 (37.2)
Occupation	
Employed	66 (13.2)
Student	3 (1.0)
Unemployed	429 (85.8)
Household income level, Rial	
< 10,000,000	228 (45.6)
10,000,000 - 20,000,000	228 (46.0)
20,000,000 - 40,000,000	40 (8)
> 40,000,000	2 (0.4)

[a] BMI: body mass index.

Table 2. Average Daily Food Consumption in the Subjects (n = 498)

Foods	Minimum	Maximum	Mean ± SD
Cereals and cereal products	0	35.5	11.1 ± 4.8
Milk and dairy products	0.13	17.0	4.7 ± 2.4
Vegetables	0	8.8	1.9 ± 1.3
Fruit	0	34.3	4.9 ± 3.0
Meat, eggs and meat products	0.33	42.0	5.5 ± 3.9
Beverages	0	25.0	8.3 ± 3.3
Sweet, baked goods and junk food	0	19.2	2.3 ± 1.8
oils and fats	0	30.0	6.0 ± 3.5

food consumption varied from 11.1 servings/day of cereal products) the highest consumption (and 1.9 servings/day of vegetables) the lowest consumption) and in the cereal group, rice (mean = 4.6 ± 2.7 servings/day) was consumed more often than the other subgroups.

4.2. Reliability and Validity

The correlation coefficients between test and retest were r = 0.845. The lowest correlation was observed in the subscale carbonated drinks (r = 0.516), whereas the highest correlations were observed in the subscales tea (r = 0.993) and milk (r = 986).

Two factors were determined by factor analysis from the dietary sources, The Kaiser-Meyer-Oilskin measure of sampling adequacy was 0.584 and all P values for the Bartlett test of sphericity were less than 0.001. Results showed that values of factor loading for all items were greater than 0.3. Principal component analysis with varimax rotation was based on 25 groups (Tables 3 and 4).

5. Discussion

The current study found high reliability of food items coefficients ranged 0.516 - 0.993 with an approximate mean value of 0.845, that were similar to those of the study by Bjornara et al. (28), the average of test-retest correlation coefficient of foods was 0.80 (from 0.54 to 0.84). In the present study, the lowest and highest values of correlation coefficients of food groups was observed in the following order: among the cereal group were 0.582 for whole meal bread and 0.975 for baguette bread; among the milk and dairy products group were 0.601 for curd and 0.986 for low-fat milk; among the vegetables group were 0.661 for cabbage and 0.976 for fresh vegetables; in the fruits group were 0.713 for melon and 0.937 for fresh fruits; among the meat, eggs and meat products group were 0.804 for egg and 0.960 for white meat; in the beverages group were 0.516 for carbonated drinks and 0.993 for tea; among the sweets, baked and junk foods group were 0.546 for salt and 0.989 for sugar and honey; among the oils and fats group were 0.577 for mayonnaise sauce and 0.978 for cream.

The correlation coefficients (i.e. the Pearson r, the Spearman rho, the Kendall tau and the Bland and Altman) are widely used in a similar design. In study in Malaysia on pregnant females, Spearman rank correlation coefficients for foods ranged from 0.13 for organ meats, onion and garlic to 0.57 for malt drink (29). Vioque et al. (2) tested the reproducibility of newly developed questionnaires for pregnant females and the average correlations for daily intake were 0.51 for major food groups. Erkkola et al. (30) found Pearson correlations from 0.03 (high-fat milk) to 0.84 (low-fat milk). The median Spearman correlation coefficient

Table 3. [Part 1] Rotated Component Matrix

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Q1																						670			
Q2																					746				
Q3																									719
Q4																						490			
Q5															572										
Q6																					366				
Q7								335																	
Q8				384																					
Q9																722									
Q10														766											
Q11															535										
Q12					757																				
Q13											568														
Q14				592																					
Q15															622										
Q16	549																								
Q17					802																				
Q18																429									
Q19														571											
Q20				449						315															
Q21					365												302								
Q22		734																							
Q23										510															
Q24																	443								
Q25		720																							
Q26		562																							
Q27																		731							
Q28																		699							
Q29																							764		
Q30										562															

in Norwegian study on children was 0.36 for often eaten foods among the nine-year-old (11) and 0.32 among the 13-year-old (31). Bountziouka et al. (32) evaluated the repeatability and the validity of a FFQ, and the repeatability of the FFQ was adequate for all food items tested (Kendall tau-b: 0.26 - 0.67, $P < 0.05$), energy and macronutrients intake.

In the validation study, factor analysis is an important tool used in the development, refinement, and evaluation of tests (33) and the Kaiser-Meyer-Olk measure of sampling and the Bartlett test of sphericity were used to determine the relationships between different variables in the factor analysis. The observed KMO was 0.584, which means that the sample was considered adequate for factor analysis and there was enough correlation between food items, and values of factor loading for all items were greater than 0.3; therefore, none of them was removed. The higher loading factor was related to fresh fruits and dark-green leafy vegetables, and lower loading factor was related to whole meal bread and bean. Exploratory factor analysis was conducted using the 25 selected food variables. In other validation studies using different methods, the validity coefficients for many dietary factors showed a good relative validity for assessment of selected food groups' intake (34-40).

5.1. Strengths and Limitations

Food frequency questionnaire is a large questionnaire which takes a long time to fill out; therefore, authors designed and validated a short food frequency questionnaire in pregnant females for the first time in Qazvin. This questionnaire provides new data on the dietary intakes in pregnant females. The other strength of this study is using factor analysis and having a large sample size. The 24 hours recall was the method to validate food frequency questionnaire. But probably this is a limitation of this study, because the 24 hours recall questionnaire is completed twice and does not show a difference of food habits, in different seasons.

Table 4. [Part 2] Rotated Component Matrix

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Q31										528															
Q32													565												
Q33													814												
Q34																							463		
Q35	666																								
Q36	732																								
Q37																				518					
Q38																				786					
Q39																	766								
Q40			323																						
Q41			773																						
Q42			775																						
Q43				489																					
Q44																558									
Q45	533																								
Q46									713																
Q47																			723						
Q48									475																
Q49																								767	
Q50																			396						
Q51												750													
Q52						666																			
Q53						799																			
Q54							765																		
Q55			.									399													
Q56											639														
Q57							771																		
Q58				695																					
Q59								628																	
Q60								652																	
Q61								681																	

In conclusion, the developed 61-item FFQ seems to be an acceptable tool to assess usual food intake during the third trimester of pregnancy. It is reliable and valid enough to assess the intake of food groups in pregnant females.

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Footnotes

Authors' Contribution: Study concept and design: Seyedeh Fatemeh Sharafi and Maryam Javadi; acquisition of data: Seyedeh Fatemeh Sharafi; interpretation of data: Seyedeh Fatemeh Sharafi; drafting of the manuscript: Seyedeh Fatemeh Sharafi; critical revision of the manuscript for important intellectual content: Maryam Javadi; statistical analysis: Ameneh Barikani; administrative, technical and material support: Maryam Javadi; study supervision: Maryam Javadi.

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